CLAIMS

1. A method of fabricating a liquid crystal display device comprising a pair of opposed and spaced substrates, an alignment layer formed on one of said substrates, an alignment layer formed on the other substrate, and a liquid crystal inserted between said pair of substrates, said method comprising the steps of:

forming an alignment layer including a polymer realizing vertical alignment on each of said substrates; and irradiating the surface of each of said alignment layers with unpolarized ultraviolet light having an exposure energy of 30 to 120 mJ/cm2 per one percent of the polymer content realizing the vertical orientation of said alignment layer in the oblique direction at an angle of not more than 45 degrees with respect to the surface of said alignment layer.

2. A method of fabricating a liquid crystal display device as described in claim 1, characterized in that the exposure energy of the unpolarized ultraviolet light irradiated on the surface of the alignment layer is in the range of 40 to 90 mJ/cm2.

3. A method of fabricating a liquid crystal display device as described in claim 1, characterized in that the exposure energy of the unpolarized ultraviolet light irradiated on the surface of the alignment layer is in the range of 80 to 120 mJ/cm2.

4. A method of fabricating a liquid crystal display device as described in claim 1, characterized in that the exposure energy of the ultraviolet light is such that a pretilt angle of the liquid crystal to the surface of the alignment layers is not more than 89.5 degrees.

5. A method of fabricating a liquid crystal display device as described in claim 1, characterized in that the ultraviolet light irradiated on the alignment layer includes a component having the wavelength not more than 280 nm.

6. A method of fabricating a liquid crystal

display device comprising a pair of opposed and spaced substrates, an alignment layer formed on one of said substrates, an alignment layer formed on the other substrate, and a liquid crystal inserted between said pair of substrates, said method comprising the steps of:

forming an alignment layer on each of said substrates; and

irradiating the surface of each of said alignment layers with ultraviolet light in the oblique direction, using a mask having a body portion and a plurality of light path changing portions arranged in said body portion corresponding to pixel pitches and having a refractive index different from that of said body portion.

7. A method of fabricating a liquid crystal display device as described in claim 6, characterized in that each of said light path changing portions has a saw-toothed shape having an equilateral triangular cross-section with a bottom side, the length of the bottom side being equal to the length of a pixel pitch, and a shielding layer is formed on a portion of said light path changing portion corresponding to the apex of said equilateral triangle.

8. A method of fabricating a liquid crystal display device as described in claim 7, characterized in that the following equation (1) is satisfied in the case where $\theta 1 \leq 60$,

$$n1\cos(3\theta 1/2) = n2\sin(\theta 2 - \theta 1/2) \quad (1)$$

and the following equation (2) is satisfied in the case where $\theta 1 > 60$,

$$n1\cos(3\theta 1/2) = n2\sin(\theta 2/2 - \theta 2) \quad (2)$$

where n1 is the refractive index of said body portion, n2 is the refractive index of said light path changing portions,

$\theta 1$ is the apex angle of the saw-toothed section, and

$\theta 2$ is the incident angle of the ultraviolet light irradiated on the alignment layer through said light path

changing portions.

9. A method of fabricating a liquid crystal display device as described in claim 8, characterized in that the refractive index n1 of the body portion, the refractive index n2 of the light path changing portions and the apex angle θ1 of the saw-toothed section have the following relationship,

$$\cos\theta 1 > n2/n1 \quad (5)$$

10. A method of fabricating a liquid crystal display device as described in claim 9, characterized in that said light path changing portions are formed of air.

11. A method of fabricating a liquid crystal display device as described in claim 6, characterized in that each of said light path changing portions is a saw-toothed shape having a trapezoidal cross-section with a bottom side the length of the bottom side being equal to the length of a pixel pitch, and a shielding film is formed on a portion of said light path changing portion corresponding to the upper side of said trapezoid.

12. A method of fabricating a liquid crystal display device as described in claim 11, characterized in that the following equation (1) is satisfied in the case where $\theta 1 \leq 60$,

$$n1\cos(3\theta 1/2) = n2\sin(\theta 2 - \theta 1/2) \quad (1)$$

and the following equation (2) is satisfied in the case where $\theta 1 > 60$,

$$n1\cos(3\theta 1/2) = n2\sin(\theta 2/2 - \theta 2) \quad (2)$$

where n1 is the refractive index of said body portion,
n2 is the refractive index of said light path changing portions,
θ1 is the apex angle of the saw-toothed section, and
θ2 is the incident angle of the ultraviolet light irradiated on the alignment layer through said light path changing portions.

13. A method of fabricating a liquid crystal display device as described in claim 12, characterized in that the refractive index n1 of the body portion, the

refractive index n2 of the light path changing portions and the apex angle θ1 of the saw-toothed section have the following relationship,

$$\cos\theta 1 > n2/n1 \quad (5)$$

14. A method of fabricating a liquid crystal display device as described in claim 13, characterized in that said light path changing portions are formed of air.

15. A method of fabricating a liquid crystal display device as described in claim 6, characterized in that said body portion of said mask has a first flat surface, a second surface on the opposite side from said first surface, and a plurality of cavities provided in said second surface, each cavity having first and second oblique surfaces arranged to diverge in the direction from said first surface toward said second surface, and a central line between said first and second oblique surfaces, said light path changing portions being formed by said cavities and a material contained in said cavities,

whereby the ultraviolet light, which is made incident to said body portion from said first surface and passing through said first oblique surface, is applied to said alignment layer in a first oblique direction, and the ultraviolet light, which is made incident to said body portion from said first surface and passing through said second oblique surface, is applied to said alignment layer in a second oblique direction opposite to said first oblique direction.

16. A method of fabricating a liquid crystal display device comprising a pair of opposed and spaced substrates, an alignment layer formed on one of said substrates, an alignment layer formed on the other substrate, a plurality of bus lines provided on one of said substrates, and a liquid crystal inserted between said pair of substrates, said method comprising the steps of:

forming an alignment layer on each of said

substrates;

preparing a mask having a body portion and a plurality of light path changing portions arranged in said body portion corresponding to pixel pitches, said body portion of said mask has a first flat surface, a second surface on the opposite side from said first surface, and a plurality of cavities provided in said second surface, each cavity having first and second oblique surfaces arranged on either side of a vertical plane perpendicular to said first surface to diverge in the direction from said first surface toward said second surface, said light path changing portions being formed by said cavities and a material contained in said cavities;

regarding the substrate having said bus lines, putting said mask on said substrate so that said vertical plane between said first and second oblique surfaces is located at a position corresponding to said bus line; and

irradiating the surface of said alignment layer of said substrate with ultraviolet light in the oblique direction, using said mask.

17. A method of fabricating a liquid crystal display device as described in claim 16, characterized in that said cavity has a saw-toothed shape having an equilateral triangular cross-section, and a shielding layer is formed at a position corresponding to an apex portion of the equilateral triangle.

18. A method of fabricating a liquid crystal display device as described in claim 16, characterized in that said cavity has a saw-toothed shape having a trapezoidal cross-section, and a shielding layer is formed at a position corresponding to an upper side of the trapezoid.

19. A method of fabricating a liquid crystal display device as described in claim 16, characterized in that said alignment layer has a vertical aligning

property by which the liquid crystal molecules align perpendicular to the surface of the substrate.

20. A method of fabricating a liquid crystal display device as described in claim 16, characterized in that said liquid crystal has birefringence of $c \Delta \varepsilon < 0$.

21. A method of fabricating a liquid crystal display device comprising a pair of opposed and spaced substrates, an alignment layer formed on one of said substrates, an alignment layer formed on the other substrate, a plurality of bus lines provided on one of said substrates, and a liquid crystal inserted between said pair of substrates, said method comprising the steps of:

forming an alignment layer on each of said substrates;

preparing a mask having a body portion and a plurality of light path changing portions arranged in said body portion corresponding to pixel pitches, said body portion of said mask has a first flat surface, a second surface on the opposite side from said first surface, and a plurality of cavities provided in said second surface, each cavity having first and second oblique surfaces arranged on either side of a vertical plane perpendicular to said first surface to diverge in the direction from said first surface toward said second surface, said light path changing portions being formed by said cavities and a material contained in said cavities;

regarding the substrate having no such bus lines, putting said mask on said substrate so that an end of said first oblique surface on said second surface and an end of said second oblique surface on said second surface are located at positions corresponding to said bus lines; and

irradiating the surface of said alignment layer of said substrate with ultraviolet light in the oblique direction, using said mask.

22. A method of fabricating a liquid crystal display device as described in claim 21, characterized in that said cavity has a saw-toothed shape having an equilateral triangular cross-section, and a shielding layer is formed at a position corresponding to an apex portion of the equilateral triangle.

23. A method of fabricating a liquid crystal display device as described in claim 21, characterized in that said cavity has a saw-toothed shape having a trapezoidal cross-section, and a shielding layer is formed at a position corresponding to an upper side of the trapezoid.

24. A method of fabricating a liquid crystal display device as described in claim 21, characterized in that said alignment layer has a vertical aligning property by which the liquid crystal molecules align perpendicular to the surface of the substrate.

25. A method of fabricating a liquid crystal display device as described in claim 21, characterized in that said liquid crystal has birefringence of $c \Delta \varepsilon < 0$.

26. A method of fabricating a liquid crystal display device comprising a pair of opposed and spaced substrates, an alignment layer formed on one of said substrates, an alignment layer formed on the other substrate, a plurality of bus lines provided on one of said substrates, and a liquid crystal inserted between said pair of substrates, said method comprising the steps of:

forming an alignment layer on each of said substrates;

preparing a mask having a body portion and a plurality of light path changing portions arranged in said body portion corresponding to pixel pitches, said body portion of said mask has a first flat surface, a second surface on the opposite side from said first surface, and a plurality of cavities provided in said second surface, first and second vertical planes being

defined perpendicular to said first surface and perpendicular to each other, each cavity having first and second oblique surfaces arranged on either side of the first vertical plane to diverge in the direction from said first surface toward said second surface, and third and fourth oblique surfaces arranged on either side of the second vertical plane to diverge in the direction from said first surface toward said second surface, said light path changing portions being formed by said cavities and a material contained in said cavities;

putting said mask on said substrate; and

irradiating the surface of said alignment layer of said substrate with ultraviolet light in the oblique direction, using said mask.

27. A method of fabricating a liquid crystal display device as described in claim 26, characterized in that said cavity has a saw-toothed shape having an equilateral triangular cross-section.

28. A method of fabricating a liquid crystal display device as described in claim 26, characterized in that said cavity has a saw-toothed shape having a trapezoidal cross-section.

29. A method of fabricating a liquid crystal display device as described in claim 26, characterized in that alignment treatment by the irradiation of ultraviolet light is carried out regarding one of the substrates having no such bus lines, and alignment treatment by the irradiation of ultraviolet light is not carried out regarding the other substrate having said bus lines.